

JEE MAIN 2024 · QUESTION PAPER

# 4 Apr 2024 Shift 2

85 questions in exam order, with answer key

| Subject                                                        | Section A multiple choice | Section B numerical value |
|----------------------------------------------------------------|---------------------------|---------------------------|
| ● <b>Physics</b>                                               | <b>18</b> Q1 to Q18       | <b>10</b> Q19 to Q28      |
| ● <b>Chemistry</b>                                             | <b>17</b> Q29 to Q45      | <b>10</b> Q46 to Q55      |
| ● <b>Mathematics</b>                                           | <b>20</b> Q56 to Q75      | <b>10</b> Q76 to Q85      |
| <b>In this PDF</b> <b>85</b> questions · answer key at the end |                           |                           |

- 1 Set a 3 hour timer and attempt the paper in one sitting, like the real exam.
- 2 In the 2021 to 2024 papers, Section B asked you to answer any 5 numerical questions per subject. Try each one here.
- 3 Check yourself against the answer key at the end. Every question names its chapter, so you can see where marks went.
- 4 Got one wrong? Tap "Step-by-step solution" at the top right of it for the full working, where available.

## Attempt this paper online

The same questions in the same order, with instant answer checking and step-by-step solutions where available.

[prepwisar.in/pyqs/paper/2024-04-04-evening](https://prepwisar.in/pyqs/paper/2024-04-04-evening) · Free, no signup needed to start

Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake?  
[prepwisar.in/feedback](https://prepwisar.in/feedback) · Terms: [prepwisar.in/terms](https://prepwisar.in/terms)

**Q1** Atomic Physics

[Step-by-step solution](#) › [prepwisar.in/questions/w3nItbf6VV](https://www.prepwisar.in/questions/w3nItbf6VV)

According to Bohr's theory, the moment of momentum of an electron revolving in 4<sup>th</sup> orbit of hydrogen atom is:

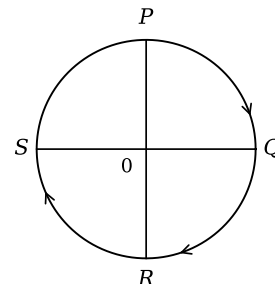
- (A)  $2 \frac{h}{\pi}$  (B)  $\frac{h}{2\pi}$  (C)  $\frac{h}{\pi}$  (D)  $8 \frac{h}{\pi}$

**Q2** Rectilinear Motion

[Step-by-step solution](#) › [prepwisar.in/questions/AT\\_KIyBFvc](https://www.prepwisar.in/questions/AT_KIyBFvc)

A cyclist starts from the point  $P$  of a circular ground of radius 2km and travels along its circumference to the point  $S$ . The displacement of a cyclist is:

- (A)  $\sqrt{8}$  km (B) 4 km (C) 6 km (D) 8 km



**Q3** Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/cwYAF6Hpr2](https://www.prepwisar.in/questions/cwYAF6Hpr2)

An electric bulb rated 50W – 200V is connected across a 100V supply. The power dissipation of the bulb is:

- (A) 100 W (B) 50 W (C) 12.5 W (D) 25 W

**Q4** Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/GLzuNOnZo5](https://www.prepwisar.in/questions/GLzuNOnZo5)

Given below are two statements: one is labelled as Assertion **A** and the other is labelled as Reason **R**.

Assertion **A**: Number of photons increases with increase in frequency of light.

Reason **R**: Maximum kinetic energy of emitted electrons increases with the frequency of incident radiation.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (A) **A** is not correct but **R** is correct.  
 (B) **A** is correct but **R** is not correct.  
 (C) Both **A** and **R** are correct and **R** is the correct explanation of **A**.  
 (D) Both **A** and **R** are correct and **R** is NOT the correct explanation of **A**.

**Q5** Electromagnetic Waves

[Step-by-step solution](#) › [prepwisar.in/questions/bUq8\\_hciqb](https://www.prepwisar.in/questions/bUq8_hciqb)

Arrange the following in the ascending order of wavelength:

- A. Gamma rays ( $\lambda_1$ )  
 B.  $x$  - rays ( $\lambda_2$ )  
 C. Infrared waves ( $\lambda_3$ )  
 D. Microwaves ( $\lambda_4$ )

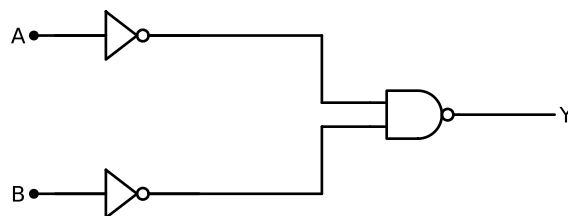
Choose the most appropriate answer from the options given below

- (A)  $\lambda_1 < \lambda_2 < \lambda_3 < \lambda_4$  (B)  $\lambda_2 < \lambda_1 < \lambda_4 < \lambda_3$  (C)  $\lambda_4 < \lambda_3 < \lambda_2 < \lambda_1$  (D)  $\lambda_4 < \lambda_3 < \lambda_1 < \lambda_2$

**Q6** Semiconductors & Electronic Devices[Step-by-step solution](https://www.prepwiser.in/questions/0Xn6aqq651) > prepwiser.in/questions/0Xn6aqq651

Identify the logic gate given in the circuit:

- (A) OR gate (B) NAND gate  
(C) NOR gate (D) AND gate

**Q7** Electrostatics I: Charges, Field & Gauss's Law[Step-by-step solution](https://www.prepwiser.in/questions/tlR8-H1p7) > prepwiser.in/questions/tlR8-H1p7

A charge  $q$  is placed at the center of one of the surface of a cube. The flux linked with the cube is:

- (A)  $\frac{q}{2\epsilon_0}$  (B) Zero (C)  $\frac{q}{4\epsilon_0}$  (D)  $\frac{q}{8\epsilon_0}$

**Q8** Gravitation[Step-by-step solution](https://www.prepwiser.in/questions/G9lxabZXlG) > prepwiser.in/questions/G9lxabZXlG

A 90kg body placed at  $2R$  distance from surface of earth experiences gravitational pull of:  
( $R$  = Radius of earth,  $g = 10\text{ms}^{-2}$ )

- (A) 300 N (B) 225 N (C) 100 N (D) 120 N

**Q9** Gravitation[Step-by-step solution](https://www.prepwiser.in/questions/keYHXprRzf) > prepwiser.in/questions/keYHXprRzf

Correct formula for height of a satellite from earths surface is:

- (A)  $\left(\frac{T^2 R^2 g}{4\pi^2}\right)^{1/3} - R$  (B)  $\left(\frac{T^2 R^2 g}{4\pi}\right)^{1/2} - R$  (C)  $\left(\frac{T^2 R^2 g}{4\pi^2}\right)^{-1/3} + R$  (D)  $\left(\frac{T^2 R^2}{4\pi^2 g}\right)^{1/3} - R$

**Q10** Thermodynamics[Step-by-step solution](https://www.prepwiser.in/questions/IN3IOZ1j1m) > prepwiser.in/questions/IN3IOZ1j1m

A sample of gas at temperature  $T$  is adiabatically expanded to double its volume. Adiabatic constant for the gas is  $\gamma = 3/2$ . The work done by the gas in the process is:  
( $\mu = 1$  mole)

- (A)  $RT[2\sqrt{2} - 1]$  (B)  $RT[2 - \sqrt{2}]$  (C)  $RT[1 - 2\sqrt{2}]$  (D)  $RT[\sqrt{2} - 2]$

**Q11** Kinetic Theory of Gases[Step-by-step solution](https://www.prepwiser.in/questions/oKPFd92Cne) > prepwiser.in/questions/oKPFd92Cne

The translational degrees of freedom ( $f_t$ ) and rotational degrees of freedom ( $f_r$ ) of  $\text{CH}_4$  molecule are:

- (A)  $f_t = 2$  and  $f_r = 2$  (B)  $f_t = 3$  and  $f_r = 3$   
(C)  $f_t = 3$  and  $4f_r = 2\$$  (D)  $f_t = 2$  and  $f_r = 3$

**Q12** Friction[Step-by-step solution](https://www.prepwiser.in/questions/vCX4UWzYAN) > prepwiser.in/questions/vCX4UWzYAN

A 2kg brick begins to slide over a surface which is inclined at an angle of  $45^\circ$  with respect to horizontal axis. The co-efficient of static friction between their surfaces is:

- (A) 1 (B) 1.7 (C) 0.5 (D)  $\frac{1}{\sqrt{3}}$

**Q13** Magnetism & Matter[Step-by-step solution](https://www.prepwiser.in/questions/km_XpqQCgj) > prepwiser.in/questions/km\_XpqQCgj

The magnetic moment of a bar magnet is  $0.5\text{Am}^2$ . It is suspended in a uniform magnetic field of  $8 \times 10^{-2}\text{T}$ . The work done in rotating it from its most stable to most unstable position is:

- (A)  $4 \times 10^{-2}\text{J}$  (B)  $16 \times 10^{-2}\text{J}$  (C)  $8 \times 10^{-2}\text{J}$  (D) Zero

**Q14** Surface Tension[Step-by-step solution](#) > [prepwiser.in/questions/3IvIGzI14](https://www.prepwiser.in/questions/3IvIGzI14)

Given below are two statements:

Statement I : The contact angle between a solid and a liquid is a property of the material of the solid and liquid as well.

Statement II : The rise of a liquid in a capillary tube does not depend on the inner radius of the tube.

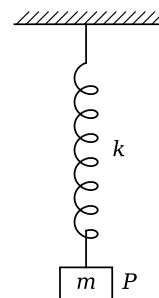
In the light of the above statements, choose the correct answer from the options given below:

- (A) Both Statement I and Statement II are false.      (B) Both Statement I and Statement II are true.  
(C) Statement I is false but Statement II is true.      (D) Statement I is true but Statement II is false.

**Q15** Simple Harmonic Motion[Step-by-step solution](#) > [prepwiser.in/questions/EhxoLNgdjh](https://www.prepwiser.in/questions/EhxoLNgdjh)

In simple harmonic motion, the total mechanical energy of given system is  $E$ . If mass of oscillating particle  $P$  is doubled then the new energy of the system for same amplitude is:

- (A)  $E/\sqrt{2}$       (B)  $2E$       (C)  $E\sqrt{2}$       (D)  $E$

**Q16** Wave Optics[Step-by-step solution](#) > [prepwiser.in/questions/X2guSg3pEz](https://www.prepwiser.in/questions/X2guSg3pEz)

The width of one of the two slits in a Young's double slit experiment is 4 times that of the other slit. The ratio of the maximum of the minimum intensity in the interference pattern is:

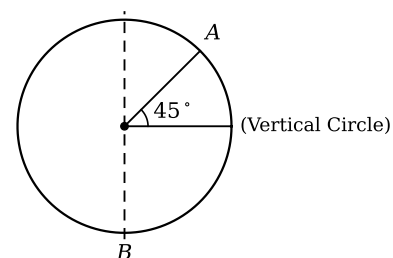
- (A) 1 : 1      (B) 4 : 1      (C) 16 : 1      (D) 9 : 1

**Q17** Work, Energy & Power[Step-by-step solution](#) > [prepwiser.in/questions/LDa0HfERTq](https://www.prepwiser.in/questions/LDa0HfERTq)

A body of  $m$  kg slides from rest along the curve of vertical circle from point  $A$  to  $B$  in friction less path. The velocity of the body at  $B$  is:

(given,  $R = 14\text{m}$ ,  $g = 10\text{m/s}^2$  and  $\sqrt{2} = 1.4$ )

- (A) 10.6 m/s      (B) 19.8 m/s      (C) 16.7 m/s      (D) 21.9 m/s

**Q18** Units, Dimensions & Errors[Step-by-step solution](#) > [prepwiser.in/questions/AxajyDJ38A](https://www.prepwiser.in/questions/AxajyDJ38A)

Applying the principle of homogeneity of dimensions, determine which one is correct, where  $T$  is time period,  $G$  is gravitational constant,  $M$  is mass,  $r$  is radius of orbit.

- (A)  $T^2 = \frac{4\pi^2 r}{GM^2}$       (B)  $T^2 = 4\pi^2 r^3$       (C)  $T^2 = \frac{4\pi^2 r^3}{GM}$       (D)  $T^2 = \frac{4\pi^2 r^2}{GM}$

**Physics Section B · Numerical value**

Q19 to Q28

**Q19** Nuclear Physics **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/qoacovSXf](https://www.prepwiser.in/questions/qoacovSXf)

The disintegration energy  $Q$  for the nuclear fission of  $^{235}\text{U} \rightarrow ^{140}\text{Ce} + ^{94}\text{Zr} + n$  is \_\_\_\_\_ MeV.

Given atomic masses of

$$^{235}\text{U} : 235.0439u; ^{140}\text{Ce} : 139.9054u; ^{94}\text{Zr} : 93.9063u; n : 1.0086u$$

, Value of  $c^2 = 931\text{MeV/u}$ .

**Q20** Electrostatics II: Potential & Capacitance **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/iHben6H1FQ) > prepwiser.in/questions/iHben6H1FQ

A parallel plate capacitor of capacitance  $12.5\text{pF}$  is charged by a battery connected between its plates to potential difference of  $12.0\text{V}$ . The battery is now disconnected and a dielectric slab ( $\epsilon_r = 6$ ) is inserted between the plates. The change in its potential energy after inserting the dielectric slab is  $\text{_____} \times 10^{-12}\text{J}$ .

**Q21** Centre of Mass & Linear Momentum **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/3TbpM4an21) > prepwiser.in/questions/3TbpM4an21

In a system two particles of masses  $m_1 = 3\text{kg}$  and  $m_2 = 2\text{kg}$  are placed at certain distance from each other. The particle of mass  $m_1$  is moved towards the center of mass of the system through a distance  $2\text{cm}$ . In order to keep the center of mass of the system at the original position, the particle of mass  $m_2$  should move towards the center of mass by the distance  $\text{_____ cm}$ .

**Q22** Current Electricity **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/iI8pphZ1oA) > prepwiser.in/questions/iI8pphZ1oA

Two wires  $A$  and  $B$  are made up of the same material and have the same mass. Wire  $A$  has radius of  $2.0\text{mm}$  and wire  $B$  has radius of  $4.0\text{mm}$ . The resistance of wire  $B$  is  $2\Omega$ . The resistance of wire  $A$  is  $\text{_____ } \Omega$ .

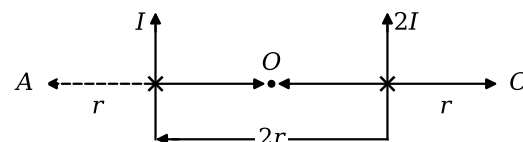
**Q23** Ray Optics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/xUutlQ0rP3) > prepwiser.in/questions/xUutlQ0rP3

A light ray is incident on a glass slab of thickness  $4\sqrt{3}\text{cm}$  and refractive index  $\sqrt{2}$ . The angle of incidence is equal to the critical angle for the glass slab with air. The lateral displacement of ray after passing through glass slab is  $\text{_____ cm}$ .

(Given  $\sin 15^\circ = 0.25$ )

**Q24** Moving Charges & Magnetism **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/u_TpgI2WTt) > prepwiser.in/questions/u\_TpgI2WTt

Two parallel long current carrying wire separated by a distance  $2r$  are shown in the figure. The ratio of magnetic field at  $A$  to the magnetic field produced at  $C$  is  $\frac{x}{7}$ . The value of  $x$  is  $\text{_____}$ .

**Q25** Electromagnetic Induction **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/8nVQpc9oa_) > prepwiser.in/questions/8nVQpc9oa\_

A rod of length  $60\text{cm}$  rotates with a uniform angular velocity  $20\text{rad s}^{-1}$  about its perpendicular bisector, in a uniform magnetic field  $0.5\text{T}$ . The direction of magnetic field is parallel to the axis of rotation. The potential difference between the two ends of the rod is  $\text{_____ V}$ .

**Q26** Rectilinear Motion **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/4MwtWY3nxu) > prepwiser.in/questions/4MwtWY3nxu

A bus moving along a straight highway with speed of  $72\text{km/h}$  is brought to halt within  $4\text{s}$  after applying the brakes. The distance travelled by the bus during this time (Assume the retardation is uniform) is  $\text{_____ m}$ .

**Q27** Fluid Mechanics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/udogeciOrz) > prepwiser.in/questions/udogeciOrz

Mercury is filled in a tube of radius  $2\text{cm}$  up to a height of  $30\text{cm}$ . The force exerted by mercury on the bottom of the tube is  $\text{_____ N}$ .

(Given, atmospheric pressure  $= 10^5\text{Nm}^{-2}$ , density of mercury

$$= 1.36 \times 10^4\text{kgm}^{-3}, g = 10\text{ms}^{-2}, \pi = \frac{22}{7})$$

The displacement of a particle executing SHM is given by  $x = 10 \sin \left( \omega t + \frac{\pi}{3} \right) \text{ m}$ . The time period of motion is 3.14s. The velocity of the particle at  $t = 0$  is \_\_\_\_\_ m/s.

## Chemistry Section A · Multiple choice

Q29 to Q45

Common name of Benzene - 1,2 - diol is -

- (A) catechol (B) quinol (C) o-cresol (D) resorcinol

Match List I with List II

|    | LIST I                                      |      | LIST II            |
|----|---------------------------------------------|------|--------------------|
| A. | $\alpha$ - Glucose and $\alpha$ - Galactose | I.   | Functional isomers |
| B. | $\alpha$ - Glucose and $\beta$ - Glucose    | II.  | Homologous         |
| C. | $\alpha$ - Glucose and $\alpha$ - Fructose  | III. | Anomers            |
| D. | $\alpha$ - Glucose and $\alpha$ - Ribose    | IV.  | Epimers            |

Choose the correct answer from the options given below:

- (A) A-III, B-IV, C-II, D-I (B) A-IV, B-III, C-I, D-II (C) A-III, B-IV, C-I, D-II (D) A-IV, B-III, C-II, D-I

The correct statement/s about Hydrogen bonding is/are

- A. Hydrogen bonding exists when H is covalently bonded to the highly electro negative atom.  
 B. Intermolecular H bonding is present in *o*-nitro phenol  
 C. Intramolecular H bonding is present in HF.  
 D. The magnitude of H bonding depends on the physical state of the compound.  
 E. H-bonding has powerful effect on the structure and properties of compounds

Choose the correct answer from the options given below:

- (A) A, B, C only (B) A only (C) A, D, E only (D) A, B, D only

The number of species from the following that have pyramidal geometry around the central atom is \_\_\_\_\_



- (A) 4 (B) 3 (C) 2 (D) 1

If an iron (III) complex with the formula  $[\text{Fe}(\text{NH}_3)_x(\text{CN})_y]^-$  has no electron in its  $e_g$  orbital, then the value of  $x + y$  is

- (A) 6 (B) 4 (C) 3 (D) 5

Attempt this paper online with instant answer checking > [prepwiser.in/pyqs/paper/2024-04-04-evening](https://www.prepwiser.in/pyqs/paper/2024-04-04-evening)

**Step-by-step solution** › [prepwiser.in/questions/ib9umqh7E9](https://www.prepwiser.in/questions/ib9umqh7E9)

(A) 0                      (B) 2                      (C) 1                      (D) 4

**Step-by-step solution** › [prepwiser.in/questions/uZUiKkzt1Z](https://www.prepwiser.in/questions/uZUiKkzt1Z)

(A) 22                      (B) 23                      (C) 26                      (D) 25

**Step-by-step solution** › [prepwiser.in/questions/Y3OJ7caPLU](https://www.prepwiser.in/questions/Y3OJ7caPLU)

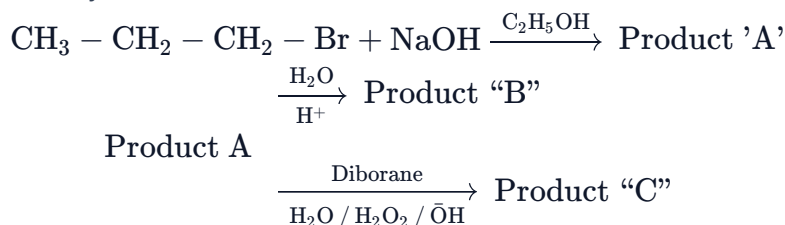
- A. has been used in spaceship
- B. has an efficiency of 40% to produce electricity
- C. uses aluminum as catalysts
- D. is eco-friendly
- E. is actually a type of Galvanic cell only

(A) A, D, E only      (B) A, B, C only      (C) A, B, D only      (D) A, B, D, E only

**Step-by-step solution** › [prepwiser.in/questions/zr5jOrZV39](https://prepwiser.in/questions/zr5jOrZV39)

(A)  $\text{Scm}^2\text{mol}^{-3/2}\text{L}$       (B)  $\text{Scm}^2\text{mol}^{-3/2}\text{L}^{-1/2}$       (C)  $\text{Scm}^2\text{mol}^{-1}\text{L}^{1/2}$       (D)  $\text{Scm}^2\text{mol}^{-3/2}\text{L}^{1/2}$

[Step-by-step solution](https://www.prepwiser.in/questions/N5a3DnWaOE) › [prepwiser.in/questions/N5a3DnWaOE](https://www.prepwiser.in/questions/N5a3DnWaOE)



(A) B = C = 1-Propanol

(B) B = 1-Propanol C = 2-Propanol

(C) B = C = 2-Propanol

(D) B = 2-Propanol C = 1-Propanol

**Step-by-step solution** › [prepwiser.in/questions/O8BFquDUjU](https://www.prepwiser.in/questions/O8BFquDUjU)

(A)  $\text{Ga} > \text{Al} > \text{B}$       (B)  $\text{Tl} > \text{Ga} > \text{Al}$       (C)  $\text{Al} > \text{Ga} > \text{Tl}$       (D)  $\text{B} > \text{Al} > \text{Ga}$

Attempt this paper online with instant answer checking › [prepwiser.in/pyqs/paper/2024-04-04-evening](https://prepwiser.in/pyqs/paper/2024-04-04-evening)

Given below are two statements:

Statement I : The correct order of first ionization enthalpy values of Li, Na, F and Cl is  $\text{Na} < \text{Li} < \text{Cl} < \text{F}$ .

Statement II : The correct order of negative electron gain enthalpy values of Li, Na, F and Cl is  $\text{Na} < \text{Li} < \text{F} < \text{Cl}$

In the light of the above statements, choose the correct answer from the options given below:

- (A) Statement I is true but Statement II is false      (B) Both Statement I and Statement II are false  
(C) Statement I is false but Statement II is true      (D) Both Statement I and Statement II are true

When  $\text{MnO}_2$  and  $\text{H}_2\text{SO}_4$  is added to a salt (A), the greenish yellow gas liberated as salt (A) is:

- (A)  $\text{NH}_4\text{Cl}$       (B)  $\text{CaI}_2$       (C)  $\text{KNO}_3$       (D)  $\text{NaBr}$

Choose the Incorrect Statement about Dalton's Atomic Theory

- (A) Compounds are formed when atoms of different elements combine in any ratio.  
(B) Matter consists of indivisible atoms.  
(C) chemical reactions involve reorganization of atoms  
(D) All the atoms of a given element have identical properties including identical mass.

The adsorbent used in adsorption chromatography is/are -

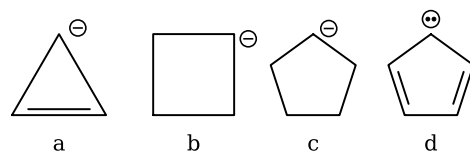
- A. silica gel  
B. alumina  
C. quick lime  
D. magnesia

Choose the most appropriate answer from the options given below:

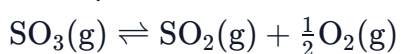
- (A) C and D only      (B) A only      (C) B only      (D) A and B only

Correct order of stability of carbanion is:

- (A)  $d > c > b > a$       (B)  $c > b > d > a$   
(C)  $d > a > c > b$       (D)  $a > b > c > d$



The equilibrium constant for the reaction



is  $K_c = 4.9 \times 10^{-2}$ . The value of  $K_c$  for the reaction given below is  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$  is:

- (A) 49      (B) 416      (C) 41.6      (D) 4.9

**Q46** Hydrocarbons: Aromatic (Arenes) **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/C08IOTCZGt) > prepwiser.in/questions/C08IOTCZGt

Vanillin compound obtained from vanilla beans, has total sum of oxygen atoms and  $\pi$  electrons is \_\_\_\_\_.

**Q47** Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/VJNUEVNL-C) > prepwiser.in/questions/VJNUEVNL-C

Number of compounds / species from the following with non-zero dipole moment is \_\_\_\_\_.

**Q48** Chemical Kinetics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/T0DkaMKHsw) > prepwiser.in/questions/T0DkaMKHsw

Consider the following reaction, the rate expression of which is given below



$$\text{rate} = k[\text{A}]^{1/2}[\text{B}]^{1/2}$$

The reaction is initiated by taking 1M concentration of A and B each. If the rate constant ( $k$ ) is  $4.6 \times 10^{-2} \text{s}^{-1}$ , then the time taken for A to become 0.1M is \_\_\_\_\_ sec. (nearest integer)

**Q49** d & f Block Elements **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/R1clIn6umd) > prepwiser.in/questions/R1clIn6umd

A first row transition metal with highest enthalpy of atomisation, upon reaction with oxygen at high temperature forms oxides of formula  $\text{M}_2\text{O}_n$  (where  $n = 3, 4, 5$ ). The 'spin-only' magnetic moment value of the amphoteric oxide from the above oxides is \_\_\_\_\_ BM (near integer)

(Given atomic number:

Sc : 21, Ti : 22, V : 23, Cr : 24, Mn : 25, Fe : 26, Co : 27, Ni : 28, Cu : 29, Zn : 30

)

**Q50** Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/SxMa1jklhI) > prepwiser.in/questions/SxMa1jklhI

2.7kg of each of water and acetic acid are mixed. The freezing point of the solution will be  $-x^\circ\text{C}$ . Consider the acetic acid does not dimerise in water, nor dissociates in water.  $x =$  \_\_\_\_\_ (nearest integer)

[Given: Molar mass of water =  $18\text{g mol}^{-1}$ , acetic acid =  $60\text{g mol}^{-1}$

$$K_f \text{H}_2\text{O} : 1.86\text{K kg mol}^{-1}$$

$K_f$  acetic acid:  $3.90\text{K kg mol}^{-1}$

freezing point:  $\text{H}_2\text{O} = 273\text{K}$ , acetic acid =  $290\text{K}$ ]

**Q51** Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/T23BWwhgGT) > prepwiser.in/questions/T23BWwhgGT

From 6.55g of aniline, the maximum amount of acetanilide that can be prepared will be \_\_\_\_\_  $\times 10^{-1}\text{g}$ .

**Q52** Atomic Structure **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/Lpjfhv1g8) > prepwiser.in/questions/Lpjfhv1g8

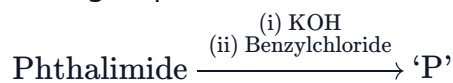
The maximum number of orbitals which can be identified with  $n = 4$  and  $m_l = 0$  is \_\_\_\_\_.

**Q53** Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/s6alCoSa_P) > prepwiser.in/questions/s6alCoSa\_P

Three moles of an ideal gas are compressed isothermally from 60L to 20L using constant pressure of 5atm. Heat exchange  $Q$  for the compression is - \_\_\_\_\_ Lit. atm.

The total number of 'sigma' and 'pi' bonds in 2-oxohex-4-ynoic acid is \_\_\_\_.

Phthalimide is made to undergo following sequence of reactions.



Total number of  $\pi$  bonds present in product 'P' is/are \_\_\_\_.

## Mathematics Section A · Multiple choice

Q56 to Q75

Let P be the point of intersection of the lines  $\frac{x-2}{1} = \frac{y-4}{5} = \frac{z-2}{1}$  and  $\frac{x-3}{2} = \frac{y-2}{3} = \frac{z-3}{2}$ . Then, the shortest distance of P from the line  $4x = 2y = z$  is

- (A)  $\frac{3\sqrt{14}}{7}$  (B)  $\frac{5\sqrt{14}}{7}$  (C)  $\frac{\sqrt{14}}{7}$  (D)  $\frac{6\sqrt{14}}{7}$

Let  $f(x) = 3\sqrt{x-2} + \sqrt{4-x}$  be a real valued function. If  $\alpha$  and  $\beta$  are respectively the minimum and the maximum values of  $f$ , then  $\alpha^2 + 2\beta^2$  is equal to

- (A) 42 (B) 38 (C) 24 (D) 44

If the coefficients of  $x^4$ ,  $x^5$  and  $x^6$  in the expansion of  $(1+x)^n$  are in the arithmetic progression, then the maximum value of  $n$  is:

- (A) 28 (B) 21 (C) 7 (D) 14

Let C be a circle with radius  $\sqrt{10}$  units and centre at the origin. Let the line  $x + y = 2$  intersects the circle C at the points P and Q. Let MN be a chord of C of length 2 unit and slope  $-1$ . Then, a distance (in units) between the chord PQ and the chord MN is

- (A)  $3 - \sqrt{2}$  (B)  $2 - \sqrt{3}$  (C)  $\sqrt{2} - 1$  (D)  $\sqrt{2} + 1$

The area (in sq. units) of the region

$$S = \{z \in \mathbb{C} : |z - 1| \leq 2; (z + \bar{z}) + i(z - \bar{z}) \leq 2, \text{Im}(z) \geq 0\}$$

is

- (A)  $\frac{7\pi}{4}$  (B)  $\frac{3\pi}{2}$  (C)  $\frac{7\pi}{3}$  (D)  $\frac{17\pi}{8}$

Let  $f(x) = \int_0^x (t + \sin(1 - e^t)) dt$ ,  $x \in \mathbb{R}$ . Then,  $\lim_{x \rightarrow 0} \frac{f(x)}{x^3}$  is equal to

- (A)  $\frac{1}{6}$  (B)  $-\frac{1}{6}$  (C)  $\frac{2}{3}$  (D)  $-\frac{2}{3}$

**Q62** Definite Integration[Step-by-step solution](#) › [prepwisar.in/questions/Wv5hcg0bqA](https://www.prepwisar.in/questions/Wv5hcg0bqA)

If the value of the integral  $\int_{-1}^1 \frac{\cos \alpha x}{1+3^x} dx$  is  $\frac{2}{\pi}$ . Then, a value of  $\alpha$  is

- (A)  $\frac{\pi}{2}$  (B)  $\frac{\pi}{4}$  (C)  $\frac{\pi}{3}$  (D)  $\frac{\pi}{6}$

**Q63** Differential Equations[Step-by-step solution](#) › [prepwisar.in/questions/UPfQPgEdOF](https://www.prepwisar.in/questions/UPfQPgEdOF)

Let  $y = y(x)$  be the solution of the differential equation  $(x^2 + 4)^2 dy + (2x^3 y + 8xy - 2) dx = 0$ . If  $y(0) = 0$ , then  $y(2)$  is equal to

- (A)  $2\pi$  (B)  $\frac{\pi}{8}$  (C)  $\frac{\pi}{16}$  (D)  $\frac{\pi}{32}$

**Q64** Hyperbola[Step-by-step solution](#) › [prepwisar.in/questions/XErmYoyDio](https://www.prepwisar.in/questions/XErmYoyDio)

Consider a hyperbola  $H$  having centre at the origin and foci on the  $x$ -axis. Let  $C_1$  be the circle touching the hyperbola  $H$  and having the centre at the origin. Let  $C_2$  be the circle touching the hyperbola  $H$  at its vertex and having the centre at one of its foci. If areas (in sq units) of  $C_1$  and  $C_2$  are  $36\pi$  and  $4\pi$ , respectively, then the length (in units) of latus rectum of  $H$  is

- (A)  $\frac{28}{3}$  (B)  $\frac{11}{3}$  (C)  $\frac{14}{3}$  (D)  $\frac{10}{3}$

**Q65** Inverse Trigonometric Functions[Step-by-step solution](#) › [prepwisar.in/questions/3qSrdS\\_kcC](https://www.prepwisar.in/questions/3qSrdS_kcC)

Given that the inverse trigonometric function assumes principal values only. Let  $x, y$  be any two real numbers in  $[-1, 1]$  such that  $\cos^{-1} x - \sin^{-1} y = \alpha$ ,  $\frac{-\pi}{2} \leq \alpha \leq \pi$ . Then, the minimum value of  $x^2 + y^2 + 2xy \sin \alpha$  is

- (A) 0 (B)  $-1$  (C)  $\frac{1}{2}$  (D)  $-\frac{1}{2}$

**Q66** Continuity & Differentiability[Step-by-step solution](#) › [prepwisar.in/questions/K7iLVTSVwD](https://www.prepwisar.in/questions/K7iLVTSVwD)

If the function

$$f(x) = \begin{cases} \frac{72^x - 9^x - 8^x + 1}{\sqrt{2} - \sqrt{1 + \cos x}}, & x \neq 0 \\ a \log_e 2 \log_e 3, & x = 0 \end{cases}$$

is continuous at  $x = 0$ , then the value of  $a^2$  is equal to

- (A) 968 (B) 1250 (C) 1152 (D) 746

**Q67** Matrices[Step-by-step solution](#) › [prepwisar.in/questions/h1YAOCsr5k](https://www.prepwisar.in/questions/h1YAOCsr5k)

Let

$$A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$$

and

$$B = I + \text{adj}(A) + (\text{adj } A)^2 + \dots + (\text{adj } A)^{10}$$

. Then, the sum of all the elements of the matrix  $B$  is:

- (A)  $-110$  (B) 22 (C)  $-124$  (D)  $-88$

Attempt this paper online with instant answer checking › [prepwisar.in/pyqs/paper/2024-04-04-evening](https://www.prepwisar.in/pyqs/paper/2024-04-04-evening)

**Q68** Parabola[Step-by-step solution](#) › [prepwisar.in/questions/on\\_wJmRPCx](#)

Let  $PQ$  be a chord of the parabola  $y^2 = 12x$  and the midpoint of  $PQ$  be at  $(4, 1)$ . Then, which of the following point lies on the line passing through the points  $P$  and  $Q$ ?

- (A)  $(3, -3)$  (B)  $(\frac{1}{2}, -20)$  (C)  $(2, -9)$  (D)  $(\frac{3}{2}, -16)$

**Q69** Probability: Advanced[Step-by-step solution](#) › [prepwisar.in/questions/fk0W9jM-nc](#)

If the mean of the following probability distribution of a random variable  $X$ :

| $X$    | 0   | 2    | 4       | 6    | 8    |
|--------|-----|------|---------|------|------|
| $P(X)$ | $a$ | $2a$ | $a + b$ | $2b$ | $3b$ |

is  $\frac{46}{9}$ , then the variance of the distribution is

- (A)  $\frac{581}{81}$  (B)  $\frac{566}{81}$  (C)  $\frac{151}{27}$  (D)  $\frac{173}{27}$

**Q70** Sequences & Series[Step-by-step solution](#) › [prepwisar.in/questions/Ib4prUzz4u](#)

The value of

$$\frac{1 \times 2^2 + 2 \times 3^2 + \dots + 100 \times (101)^2}{1^2 \times 2 + 2^2 \times 3 + \dots + 100^2 \times 101}$$

is

- (A)  $\frac{305}{301}$  (B)  $\frac{306}{305}$  (C)  $\frac{32}{31}$  (D)  $\frac{31}{30}$

**Q71** Sequences & Series[Step-by-step solution](#) › [prepwisar.in/questions/Keb24SOazZ](#)

Let three real numbers  $a, b, c$  be in arithmetic progression and  $a + 1, b, c + 3$  be in geometric progression. If  $a > 10$  and the arithmetic mean of  $a, b$  and  $c$  is 8, then the cube of the geometric mean of  $a, b$  and  $c$  is

- (A) 120 (B) 316 (C) 312 (D) 128

**Q72** Relations & Functions (Basic)[Step-by-step solution](#) › [prepwisar.in/questions/IuVvyEkjU0](#)

Let a relation  $R$  on  $\mathbb{N} \times \mathbb{N}$  be defined as:  $(x_1, y_1) R (x_2, y_2)$  if and only if  $x_1 \leq x_2$  or  $y_1 \leq y_2$ . Consider the two statements:

(I)  $R$  is reflexive but not symmetric.

(II)  $R$  is transitive

Then which one of the following is true?

- (A) Only (II) is correct. (B) Both (I) and (II) are correct.  
(C) Neither (I) nor (II) is correct. (D) Only (I) is correct.

**Q73** Vectors[Step-by-step solution](#) › [prepwisar.in/questions/irWfjQa0F2](#)

For  $\lambda > 0$ , let  $\theta$  be the angle between the vectors  $\vec{a} = \hat{i} + \lambda\hat{j} - 3\hat{k}$  and  $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$ . If the vectors  $\vec{a} + \vec{b}$  and  $\vec{a} - \vec{b}$  are mutually perpendicular, then the value of  $(14 \cos \theta)^2$  is equal to

- (A) 25 (B) 50 (C) 20 (D) 40

Attempt this paper online with instant answer checking › [prepwisar.in/pyqs/paper/2024-04-04-evening](#)

**Q74** Vectors[Step-by-step solution](#) › prepwiser.in/questions/2DtZCq74Fs

Let  $\vec{a} = \hat{i} + \hat{j} + \hat{k}$ ,  $\vec{b} = 2\hat{i} + 4\hat{j} - 5\hat{k}$  and  $\vec{c} = x\hat{i} + 2\hat{j} + 3\hat{k}$ ,  $x \in \mathbb{R}$ . If  $\vec{d}$  is the unit vector in the direction of  $\vec{b} + \vec{c}$  such that  $\vec{a} \cdot \vec{d} = 1$ , then  $(\vec{a} \times \vec{b}) \cdot \vec{c}$  is equal to

- (A) 3 (B) 9 (C) 11 (D) 6

**Q75** Area Under Curves[Step-by-step solution](#) › prepwiser.in/questions/x3SEjcHE4o

The area (in sq. units) of the region described by  $\{(x, y) : y^2 \leq 2x, \text{ and } y \geq 4x - 1\}$  is

- (A)  $\frac{9}{32}$  (B)  $\frac{11}{12}$  (C)  $\frac{8}{9}$  (D)  $\frac{11}{32}$

**Mathematics Section B · Numerical value**

Q76 to Q85

**Q76** Three Dimensional Geometry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/da5IloCzDt

Consider a line  $L$  passing through the points  $P(1, 2, 1)$  and  $Q(2, 1, -1)$ . If the mirror image of the point  $A(2, 2, 2)$  in the line  $L$  is  $(\alpha, \beta, \gamma)$ , then  $\alpha + \beta + 6\gamma$  is equal to \_\_\_\_\_.

**Q77** Differential Equations **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/0HA6oWYRN4

Let  $y = y(x)$  be the solution of the differential equation  $(x + y + 2)^2 dx = dy$ ,  $y(0) = -2$ . Let the maximum and minimum values of the function  $y = y(x)$  in  $[0, \frac{\pi}{3}]$  be  $\alpha$  and  $\beta$ , respectively. If  $(3\alpha + \pi)^2 + \beta^2 = \gamma + \delta\sqrt{3}$ ,  $\gamma, \delta \in \mathbb{Z}$ , then  $\gamma + \delta$  equals \_\_\_\_\_.

**Q78** Applications of Derivatives **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/idYVUYXmT

Let  $f : \mathbb{R} \rightarrow \mathbb{R}$  be a thrice differentiable function such that  $f(0) = 0$ ,  $f(1) = 1$ ,  $f(2) = -1$ ,  $f(3) = 2$  and  $f(4) = -2$ . Then, the minimum number of zeros of  $(3f'f'' + ff''')(x)$  is \_\_\_\_\_.

**Q79** Relations & Functions (Basic) **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/YCmx4CAp4Y

Consider the function  $f : \mathbb{R} \rightarrow \mathbb{R}$  defined by  $f(x) = \frac{2x}{\sqrt{1+9x^2}}$ . If the composition of

$$f, \underbrace{(f \circ f \circ f \circ \dots \circ f)}_{10 \text{ times}}(x) = \frac{2^{10}x}{\sqrt{1+9\alpha x^2}}$$

, then the value of  $\sqrt{3\alpha + 1}$  is equal to \_\_\_\_\_.

**Q80** Matrices **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/ul-RsG75zs

Let  $A$  be a  $2 \times 2$  symmetric matrix such that

$$A \begin{bmatrix} 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ 7 \end{bmatrix}$$

and the determinant of  $A$  be 1. If  $A^{-1} = \alpha A + \beta I$ , where  $I$  is an identity matrix of order  $2 \times 2$ , then  $\alpha + \beta$  equals \_\_\_\_\_.

**Q81** Permutations & Combinations **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/qaoE2yYiUV

There are 4 men and 5 women in Group A, and 5 men and 4 women in Group B. If 4 persons are selected from each group, then the number of ways of selecting 4 men and 4 women is \_\_\_\_\_.

**Q82** Probability: Advanced **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/KZT4COv\_AS

In a tournament, a team plays 10 matches with probabilities of winning and losing each match as  $\frac{1}{3}$  and  $\frac{2}{3}$  respectively. Let  $x$  be the number of matches that the team wins, and  $y$  be the number of matches that team loses. If the probability  $P(|x - y| \leq 2)$  is  $p$ , then  $3^9 p$  equals \_\_\_\_\_.

Let

$$S = \{\sin^2 2\theta : (\sin^4 \theta + \cos^4 \theta) x^2 + (\sin 2\theta)x + (\sin^6 \theta + \cos^6 \theta) = 0$$

has real roots  $\}$ . If  $\alpha$  and  $\beta$  be the smallest and largest elements of the set  $S$ , respectively, then  $3((\alpha - 2)^2 + (\beta - 1)^2)$  equals \_\_\_\_\_.

If  $\int \operatorname{cosec}^5 x dx = \alpha \cot x \operatorname{cosec} x (\operatorname{cosec}^2 x + \frac{3}{2}) + \beta \log_e \left| \tan \frac{x}{2} \right| + C$  where  $\alpha, \beta \in \mathbb{R}$  and  $C$  is the constant of integration, then the value of  $8(\alpha + \beta)$  equals \_\_\_\_\_.

Consider a triangle  $ABC$  having the vertices  $A(1, 2)$ ,  $B(\alpha, \beta)$  and  $C(\gamma, \delta)$  and angles  $\angle ABC = \frac{\pi}{6}$  and  $\angle BAC = \frac{2\pi}{3}$ . If the points  $B$  and  $C$  lie on the line  $y = x + 4$ , then  $\alpha^2 + \gamma^2$  is equal to \_\_\_\_\_.

## Answer key: JEE Main 2024 · 4 Apr · Shift 2

Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake? [prepwiser.in/feedback](https://prepwiser.in/feedback) · Terms: [prepwiser.in/terms](https://prepwiser.in/terms)

Numbers match the question numbers above. For full working, open the solution link at the top right of each question.

Attempt this paper online with instant answer checking › [prepwiser.in/pyqs/paper/2024-04-04-evening](https://prepwiser.in/pyqs/paper/2024-04-04-evening)

### Physics

|       |        |         |         |       |        |       |       |
|-------|--------|---------|---------|-------|--------|-------|-------|
| 1. A  | 2. A   | 3. C    | 4. A    | 5. A  | 6. A   | 7. A  | 8. C  |
| 9. A  | 10. B  | 11. B   | 12. A   | 13. C | 14. D  | 15. D | 16. D |
| 17. D | 18. C  | 19. 208 | 20. 750 | 21. 3 | 22. 32 | 23. 2 | 24. 5 |
| 25. 0 | 26. 40 | 27. 177 | 28. 10  |       |        |       |       |

### Chemistry

|         |        |       |        |       |        |        |       |
|---------|--------|-------|--------|-------|--------|--------|-------|
| 29. A   | 30. B  | 31. C | 32. D  | 33. A | 34. A  | 35. B  | 36. A |
| 37. D   | 38. D  | 39. B | 40. D  | 41. A | 42. A  | 43. D  | 44. A |
| 45. B   | 46. 11 | 47. 5 | 48. 50 | 49. 0 | 50. 31 | 51. 95 | 52. 4 |
| 53. 200 | 54. 18 | 55. 8 |        |       |        |        |       |

### Mathematics

|       |          |          |       |       |        |       |          |
|-------|----------|----------|-------|-------|--------|-------|----------|
| 56. A | 57. A    | 58. D    | 59. A | 60. B | 61. B  | 62. A | 63. D    |
| 64. A | 65. A    | 66. C    | 67. D | 68. B | 69. B  | 70. A | 71. A    |
| 72. D | 73. A    | 74. C    | 75. A | 76. 6 | 77. 31 | 78. 5 | 79. 1024 |
| 80. 5 | 81. 5626 | 82. 8288 | 83. 4 | 84. 1 | 85. 14 |       |          |

PrepWiser is an independent practice platform and is not affiliated with the National Testing Agency (NTA). Questions are from official JEE Main papers; answers follow NTA's final answer keys.



# Attempt this paper online

Done with the paper version? Take the same paper online: check each answer instantly and read step-by-step solutions where available. It is free, and you can start without signing up.



- 1 Scan the code to open this paper online, or go to [prepwisser.in/pyqs/paper/2024-04-04-evening](https://prepwisser.in/pyqs/paper/2024-04-04-evening).
- 2 Mark the questions you got wrong. Each one names its chapter at the top left.
- 3 Practise those chapters next with the free chapter-wise PYQ PDFs at [prepwisser.in/pyq-pdfs](https://prepwisser.in/pyq-pdfs).

## Also free on PrepWiser

### All JEE Main 2024 papers

Every shift of 2024 as a PDF, and the year's questions chapter-wise: [prepwisser.in/pyq-pdfs/jee-main/2024/](https://prepwisser.in/pyq-pdfs/jee-main/2024/)

### Chapter-wise PYQ PDFs

Every chapter with answer keys, 2020 to 2026: [prepwisser.in/pyq-pdfs/](https://prepwisser.in/pyq-pdfs/)

### Daily Arena

10 questions from one chapter, every day: [prepwisser.in/arena](https://prepwisser.in/arena)

Spotted a mistake in this PDF? Tell us at [prepwisser.in/feedback](https://prepwisser.in/feedback).